

ABSTRACT

Biomass is one of carbon sources for alternative energy source. Hydrothermal treatment, a thermochemical process can be used to increase the biomass heating value. Hydrothermal treatment in this research was conducted for sawdust and corn cobs at 200°C, 240°C, 270°C, 300°C, and 330°C. The biomass hydrothermal treatment is divided into three-phase processes: pre-heating, heating, and cooling. The products of the hydrothermal treatment are hydrochar, liquid, and gas. Hydrochar as the main product was analyzed using proximate analysis (water content, ash content, volatile matter, fixed carbon), heating value analysis, and Fourier Transform InfraRed (FTIR) analysis. The liquid product of the hydrothermal treatment was analyzed using Gas Chromatography Mass Spectroscopy (GCMS). It was found that the highest hydrochar calorific value was 7032 cal/gram at 330°C for hydrochar from sawdust and 6919 cal/gram from the corn cobs powder at the same temperature. The composition of the biomass mixture sawdust and corncobs affect of hydrochar quality. Increasing percentage of sawdust will increase the heating value, raising hydrochar yield, increasing energy yield and decreasing potassium content. It can be occurred because sawdust has more lignin and cellulose content so that increasing the conversion of biomass to hydrochar.

The analysis result using Gas Chromatography Mass Spectroscopy (GCMS) showed that organic compounds, such as alcohol and the derivatives, acetic acid, and furfural were found. These organic compounds can be processed through further separation, to be used as chemical feedstocks. Based on the regression analysis of the proximate analysis using this study and previous researches data, it was found that the water content, ash content, volatile matter (VM) dan fixed carbon (FC) are statistically significant to hydrochar heating value with the regression equation of heating value: $HHV = 0.837(\%AC) + 0.152(\%VM) + 0.389(\%FC) - 0.022(\%WC)$

The average absolute error of 4,11% and bias error of 0,28% with respect to measured values of heating value.

Keywords: Biomass, Sawdust, Corn Cobs, Hydrothermal Treatment

INTISARI

Biomassa merupakan salah satu sumber karbon yang dapat dipakai sebagai sumber energi alternatif. *Hydrothermal treatment* merupakan salah satu proses yang dapat digunakan untuk meningkatkan nilai kalor biomassa secara termokimia. *Hydrothermal treatment* pada penelitian ini dilakukan terhadap biomassa serbuk gergaji kayu jati dan serbuk tongkol jagung serta digunakan variasi temperatur operasi 200°C, 240°C, 270°C, 300°C, dan 330°C. *Hydrothermal treatment* biomassa ini dibagi menjadi tiga tahapan proses yaitu *pre-heating*, *heating*, dan *cooling*. Produk dari *hydrothermal treatment* biomassa ini adalah produk padatan yang disebut dengan *hydrochar*, produk cairan, dan gas. *Hydrochar* sebagai produk utama dilakukan proses analisis yang meliputi analisis proksimat (kadar air, kadar abu, *volatile matter*, *fixed carbon*), analisis nilai kalor, dan analisis FTIR (*Fourier Transform Infra Red*). Produk cairan hasil *hydrothermal treatment* dianalisis menggunakan GCMS (*Gas Chromatography Mass Spectroscopy*). Berdasarkan data kuantitatif dapat diketahui bahwa nilai kalor *hydrochar* tertinggi terdapat pada temperatur operasi 330°C, yaitu 7032 kal/gram untuk *hydrochar* dari serbuk gergaji kayu jati dan 6919 kal/gram untuk *hydrochar* dari serbuk tongkol jagung. Komposisi campuran biomassa serbuk gergaji kayu jati dan serbuk tongkol jagung mempengaruhi kualitas *hydrochar* hasil *hydrothermal treatment*. Semakin besar persentase serbuk gergaji kayu jati akan menaikkan nilai kalor, menaikkan yield *hydrochar*, menaikkan energi yield, dan menurunkan kadar kalium. Hal ini dapat terjadi karena semakin besar persentase serbuk gergaji kayu jati maka semakin banyak kandungan lignin dan selulosa dalam biomassa sehingga meningkatkan konversi biomassa menjadi *hydrochar*. Hasil analisis produk cair menggunakan GCMS yaitu dihasilkan senyawa-senyawa organik seperti alkohol dan turunannya, asam asetat, dan furfural. Senyawa-senyawa organik ini dapat diproses lebih lanjut sehingga dihasilkan senyawa-senyawa organik sebagai sumber *chemical feedstock*. Berdasarkan analisis regresi multivariat didapatkan hasil bahwa kadar air (WC), kadar abu (AC), *volatile matter* (VM) dan *fixed carbon* (FC) berpengaruh secara signifikan terhadap nilai kalor *hydrochar* dengan persamaan regresi: $HHV = 0,837(\%AC) + 0,152(\%VM) + 0,389(\%FC) - 0,022(\%WC)$ dan nilai kesalahan rata-rata absolut sebesar 4,11% serta nilai kesalahan rata-rata bias sebesar 0,28%.

Kata Kunci: Biomassa, Serbuk Gergaji Kayu Jati, Serbuk Tongkol Jagung, *Hydrothermal Treatment*